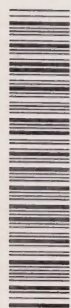


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ECOCYCLE

newsletter on
life-cycle tools,
management and
product policy.

Summer/Fall 1996
Issue no. 4

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I RECENTLY SPENT TWO WEEKS ON A STUDY MISSION IN SWEDEN and the Netherlands visiting with industries, financial institutions, educational foundations, and representatives of local and national governments. The purpose was to evaluate

editor's column

how various sectors of society are imbedding sustainability into their respective activities. I came away with a clearer vision of some of the core elements of a sustainable society. This is not to say that Sweden and the Netherlands are sustainable societies, but they are taking meaningful steps in the right direction.

A clear vision or framework of what a sustainable society will look like is key. According to John Holmberg of Chalmers University in Sweden, such a framework provides a planning tool that allows a society to design its way to a sustainable future. It can also be used to refute alternative visions that do not fit into a sustainable society. Without a shared vision, actions seem ad hoc and arbitrary. This has seriously hampered our progress toward sustainability. In the words of Holmberg, "The fact that the GNP is more of a reality than natural laws is a serious problem."

Relationships among government, industry and consumers — based on a clear understanding of roles and responsibilities — are also important. In a sustainable society there is no "us" and "them", only us. A willingness to work cooperatively is crucial, but each participant should understand their own power and influence. Governments must help set the boundaries, develop the vision in partnership with other sectors, and regulate when necessary. Business and

industry must do, create, innovate, and derive better ways to make products and deliver services. Consumers must exercise their purchasing power and demand more sustainable products.

Another core element of a sustainable society is a certain level of awareness within all sectors about the limits and constraints nature places on consumption and production. While natural laws are well accepted in the scientific community, there remains a need for a common understanding of their relevance to human activity over the long term. A product manufacturer who understands that human-made substances cannot be allowed to systematically increase in nature, for example, is much closer to a solution than a manufacturer whose focus is determining arbitrary environmental thresholds for those substances.

A sustainable society must also include keystone individuals and groups willing to exert their leverage to move society toward innovation. A CEO with a clear vision and a sense of corporate responsibility, or a government willing to make an example of an industry sector that is foot-dragging on a covenant or extended producer responsibility regulation, is critical to achieving breakthroughs in sustainable production and consumption.

A number of well-documented case studies and success stories show the economic benefits of integrating sustainability into business strategy. After all, you can't argue with success! Businesses most active in sustainable development have not undergone a radical conversion to environmentalism; rather they have conducted pilot projects resulting in economic and environmental benefits. These small successes have then been used to gain leverage within the organisation, and to educate

continued on page 2

editor's column

Continued from page 1

other management players about the potential benefits of integrating environmental considerations into business operations.

Successful implementation of sustainable development requires appropriate tools. Two general trends are evident in the types of tools companies and governments are developing and using. The first is a move towards environmental management systems and away from detailed auditing-type procedures. The second is the evaluation of environmental impacts throughout the product life cycle. In

Sweden these trends are evident in manufacturing, government, and the financial community, demonstrating a depth of understanding about product systems and systems thinking that is not readily apparent in North America.

These core elements are presented with some reticence since there is a danger in condensing any intensive learning experience. The result can be rather trite statements that simply reflect common sense. The reality, however, is that sustainable development is common sense. Have we then over-complicated our analysis of how to move to a more sustainable society?

The core elements presented are incomplete in that they do not address the human side of sustainable development. This is a challenge for another time.

This issue of *Ecocycle* details some of the activities I witnessed in Sweden, as well as a few North American initiatives. I hope you find it interesting.

Kevin Brady is writing a series of reports on his study mission to Sweden and the Netherlands. The first, now available, expands on issues raised in this column. Further reports to follow will detail activities of financial institutions, industries, communities, foundations, government, and academia. To order this free series refer to the Publisher's Message for contact information. ●

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publisher's message

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NEW REPORT!!

"Evaluation of Life-Cycle Assessment Tools"

This study, commissioned by Environment Canada, profiled 37 software tools for life-cycle assessment (LCA) and reviewed 5 in-depth. The University of Tennessee completed the study by:

- making a list of software tools currently available for LCA;
- reviewing documentation and demo versions, as well as views of third-party sources;
- developing criteria for in-depth evaluation; and
- evaluating 5 software tools in full.

The criteria covered computer requirements, system definitions, data and data management, flexibility, calculations and comparisons, and outputs and exports. The manuscript, available in English only, as part of Environment Canada's Manuscript Series, includes a list of vendors and their contact information, as well as details of the study and results.

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LCM across the life cycle

Considering your role in the total life cycle of products and services

EACH COMPANY OR INDIVIDUAL CAN PARTICIPATE in their own stage of the life cycle. In fact, you can affect elements at other stages as well, contributing to overall environmental improvements. For example, some of your decisions may relate to activities within

your own company. Others, like choosing suppliers with minimal environmental impact or raising awareness among consumers, may be more external in nature.

While reliable information and life-cycle management (LCM) tools are important, even the simplest

actions can result in genuine improvements in resource efficiency and pollution prevention. Any organisation can start LCM immediately. The following table provides examples of how you could make a difference. ●



Product Design

A designer should consider all life-cycle stages. A life-cycle review and life-cycle design tools might be used to support decisions regarding the composition of a specific component.



Energy

A utilities manager might use a streamlined life-cycle assessment (LCA) to help assess the environmental profile of their non-power-generating operations, including materials consumption and maintenance.



Materials Production

An environmental engineer might use a life-cycle inventory (LCI) to base-line their operations' performance against generic data and help guide pollution prevention and process improvements.



Materials Processing

A materials processor might combine external LCI data with an input/output inventory of their own activities to generate LCIs or LCAs of their finished or semi-finished products.



Manufacturing

A manufacturer might provide consumers with environmental profiles of finished products based on input/output accounts of their own activities, their materials and energy use, and external data. The manufacturer can influence downstream users of their products while simultaneously meeting changing customer requirements.



Transportation

A transport manager might provide environmental profiles of transportation options to clients. The manager could also assist with recovering used products or packaging for re-use, recycling or energy recovery.



Product Use

A procurement officer might use environmental labelling information or LCI data from suppliers to help meet company policies concerning the use of resources and the reduction of specific environmental emissions, both internal and external to the organisation.



End-of-Life

A municipal 3R's manager might use LCA studies to gain a better understanding of solid waste generation and sources over the life cycle of products.

CASE STUDY: ASG

ASG – Reducing environmental impact & increasing

SUSTAINABLE PROFITABILITY THROUGH ENVIRONMENTAL WORK”: while these objectives may seem contradictory, that’s the title of the first section of ASG’s 1995 *Environmental Report*, and it’s an approach to business and the environment that seems to be working. Who is ASG? One of the Nordic countries’ leading transportation and logistics companies, with 9,750 employees and an annual turnover of about \$2.2 billion (CAN).

According to ASG, transport and logistics form the foundation of modern society and are therefore of strategic importance. While they acknowledge that these types of operations affect the environment negatively, they approach their environmental work with high demands, often exceeding legal requirements. It’s a strategy they believe will lead to both reduced environmental impacts and new business opportunities.

So how can they focus on keeping financial profitability high in the

long term while reducing their environmental impact and increasing the quality of their services? ASG believes that serious and long-term environmental work will provide competitive advantages in the form of more customers, lower costs through greater resource efficiency, better lending conditions, and lower insurance premiums.

Already, several leading companies in Europe have contracted ASG with regard to business co-operation involving substantive environmental demands. Investors and lending institutions have also begun to place such demands. ASG has also been contacted by European banks and institutions that represent ethical funds.

In fact, many ASG customers have shown a more concrete interest in environmental issues. Several have proposed joint development of transportation and logistics solutions aimed at reducing environmental impact. One client, Baxter Medical, recently demanded an external environmental audit of

some of ASG’s facilities and operations, an example of the increasing trend among international companies to ensure their operations meet both internal and external environmental demands world-wide.

Another trend identified in ASG’s *Environmental Report* is the examination of products through life-cycle assessments or other life-cycle tools, which includes the environmental impact of the logistics of transportation and packaging. The company foresees the possibility of future production patterns incorporating greater local dispersion, thereby reducing the need for transportation.

In preparation, ASG is taking action on two fronts. They are increasing efficiency in transportation and becoming involved in logistics consulting concerning the design of products and packaging. These two steps help minimise resource consumption and reduce environmental impact. So does mixed loading of goods, a cornerstone

CASE STUDY: SWEDISH FINANCE INDUSTRY

Green finance – Sweden’s latest trend

SWEDEN’S ENVIRONMENT MINISTER CHALLENGED THE SWEDISH FINANCE INDUSTRY to contribute to sustainable development. The result has been the development of a number of environmental mutual funds. Two in particular are making great strides in encouraging sustainability.

Föreningsbanken, a Swedish banking institution, has created FB Miljöfond. The fund gives far greater emphasis to environmental criteria than traditional mutual

funds. Its criteria include companies which have a prominent position in their respective industries in regard to environmental adaptation.

The environmental analysis used covers four broad categories, including:

- **Environmental Leadership** – the company’s management role; environmental policy; organisation; and employees’ knowledge and commitment.
- **Environmental Control System** – an environmental control system and environmental audits.

- **Openness in Environmental Work** – environmental reporting; the inclusion of an environmental section in annual reports; and dialogue with interested parties.

- **Environmental Adaptation of Products and Product Methods** – development work; material and energy consumption; renewable raw materials; recycled materials; renewable energy; transport; emissions and waste; eco-labelling and

profits

of ASG's logistics approach, and the company's Green Return program which involves returning used products and packaging for reuse, recycling or energy recovery.

ASG's environmental activities have begun to resemble a life-cycle management approach through information sharing about environmental impacts. The company has developed an environmental index to rate their sub-contracted service suppliers, as well as environmental eco-performance charts. These charts, based on life-cycle transportation data for up to 100 different transport options, are available to ASG customers.

With the extensive efforts ASG has made to distinguish itself on the European market, it is hardly surprising that one of their goals for 1996 involves the environmental training of all staff and drivers. If past performance is any indication, this new goal is bound to be met with resounding success. ●

CASE STUDY: JM BYGGNADS OCH FASTIGHETS AB Building a better future

JM BYGGNADS OCH FASTIGHETS AB IS ONE OF THE LARGEST BUILDERS OF HOUSING in Sweden, with 2,300 employees and approximately \$796 million (CAN) in invoiced sales in 1994. Two years ago, JM adopted an environmental policy that made human health and environment issues a core concern. This policy is now central to their entire building operations.

To meet their own environmental objectives, the company began considering the broader life-cycle impacts of their activities, in addition to researching methods of integrating planning for the environment and nature cycles into their building operations.

Currently, JM requires suppliers and sub-contractors to provide materials specifications so that customers can be provided with a description of materials contained in JM-built houses. Descriptions will include both health-related and nature-cycle information. Further, JM requires all co-workers to be environmentally aware. Their own

employees receive environmental training in collaboration with The Natural Step Foundation.

Efforts are also being made to minimise residual waste through well-implemented project planning and meticulous purchasing practices. Any surplus materials, packaging, and demolition waste from JM projects are taken back, recovered, or handled in a way that is as environmentally friendly as possible.

Another focus involves building houses that are healthier and more environmentally responsible. As a pilot project, JM is building 88 condominiums that offer cultivation plots, compost units or free-standing earth cellars for food storage. The area will be automobile-free, and all rain water, melting snow and ice will be handled by the individual dwellings. Another JM venture includes involvement in a research project for an allergy-friendly multi-dwelling building.

Future plans include "environmentally grading" their buildings and developing environmental criteria for installation buildings. Targets for environmentally adapted housing involve: planning for the environment and nature's life cycle; ease of cleaning; good air quality; saving electricity; building material specifications; and resource-saving solutions for material management.

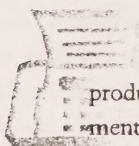
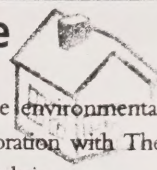
JM's environmental activity is in part driven by market and governmental pressure in the form of extended producer responsibility regulation. However, the company believes that their approach to the environmental aspects of their business will be profitable in the long term and will distinguish them from their competition. ●

product information; environmental assessment of suppliers; chemical control; violations of environmental laws and permits; and occupational injuries.

The second noteworthy fund, the Swedish Environmental Fund, is a continued collaboration between The Natural Step Foundation and Banco Fonds. Initiated by Natural Step, the fund highlights companies that have set a good environmental example, thereby

encouraging all companies to adopt environmental concerns, thinking, and actions.

Last spring, The Natural Step released its annual Top Performers list detailing Swedish companies that meet the Foundation's stringent criteria for sustainable development. The list is designed to advise investors of Swedish companies under consideration for investment. Only those profitable and well-positioned environmentally are included. ●



CASE STUDY: ELECTROLUX

Environmental considerations: A tool for success

WHY IS ELECTROLUX SO SUCCESSFUL ON THE WORLD MARKET? One reason could be their approach to new products and technologies. Many of the company's recent changes to product design and production processes take environmental impact into consideration, with constant life-cycle improvement top of mind. As one of the world's leading manufacturers of both household and commercial equipment, the company's approach is an important example for others in the industry to follow and a key consideration for a growing number of consumers.

Electrolux's product development focuses on continuing industrial operations while adopting environmental innovations. Using

life-cycle assessments (LCAs) of different product groups, Electrolux can prioritise their activities based on relative environmental impact. For example, LCAs of white goods show that over 90% of environmental impact occurs while the appliances are in operation. As a result, more time is spent improving the energy efficiency of these products.

The company's recent environmental achievements have included eliminating ozone-depleting impacts by phasing out the use of chlorofluorocarbons (CFCs) from production in Europe and the United States. In 1994, Electrolux took CFC-free technology one step further with the introduction of hydrocarbon (isobutane and

cyclopentane), which also reduces contributions to the greenhouse effect. Further, the company reduced their total global energy consumption by 8% from 1990 to 1993. And because Electrolux determined that rail transportation has less impact on the environment than other modes, they now use it for more than 75% of product transportation in Europe.

From The Natural Step's four system conditions (see article "Taking the Natural Step" in *Ecocycle* Issue #3, Winter/Spring 1996), Electrolux has developed related principles in business terms to guide their activities, leading to further product and operations improvements. Examples include development of a solar-powered lawn

CASE STUDY: GOTHENBURG

Gothenburg puts Agenda 21 into action

AGENDA 21 WAS DRAFTED AT THE 1992 UNITED NATIONS CONFERENCE IN RIO DE JANEIRO to deal with the universal problems of poverty and environmental degradation. The 130 participating countries were to start their own Agenda 21 work through co-operative local efforts involving all members of society. Gothenburg, Sweden, is an example of how well this approach works.

Co-operation has been the driving force behind environmental development in Gothenburg over the past several years. Industry has co-operated with the general public and has discovered that green business pays. The two local universities support environmental work and emphasise the need for widespread

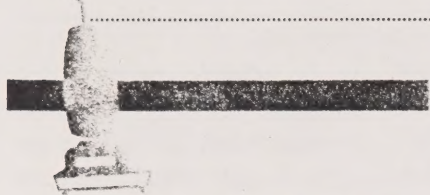
information and education. Although the central government's role has been mainly legislative, the municipal government has been key in initiating environmental actions in the community.

Two environmental projects, Clean Out and Chemical Sweep, are the result of a successful collaboration between industry and the municipality. Clean Out is an initiative to reduce waste, especially hazardous waste and sewage. Chemical Sweep works toward a reduction of hazardous substance usage in the workplace. The city has also adopted a waste plan to encourage composting in households and has distributed an *Eco Handbook* on product selection, energy conservation and waste

management to every household and workplace.

To tackle air pollution, the local energy company developed a new district heating system used by two-thirds of all households in Gothenburg. From 1984 to 1991, this revolutionary system reduced carbon dioxide emissions by 50% and sulphurous emissions by 94%. An air-quality management system has also recently been installed to monitor everything from dangerous emissions to the weather.

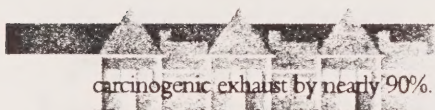
On the transportation front, industry has initiated several programs including natural gas buses and trucks, electric cars, and diesel catalysts for heavy vehicles. The natural gas bus program, for example, has reduced particle and



mower, a washing machine that stores water from the rinse cycle to wash the next load, and a shift to water-based paints.

An active participant in charitable work for environmental causes, Electrolux is involved in several programs including a Canadian initiative where a portion of the profits from vacuum cleaner sales goes to the Canadian National Parks Partnership.

Although other companies are beginning to make the connection between economics and ecology, Electrolux continues to be a market leader with new products and technologies that are developed and incorporated using environmental thinking at all levels of the organisation. ●



carcinogenic exhaust by nearly 90%. The city has also taken action, reducing high volumes of inner-city traffic. Gothenburg has been divided into three traffic zones, making it difficult to drive through the centre. Other areas prohibit vehicles that fail to meet specific environmental standards.

Local companies have also initiated projects which help to make a difference to the environment. Volvo is a good example, developing vehicles that run on electricity, natural gas or biogas, and alcohol. Their new line of diesel trucks consume 10% less fuel than similar vehicles.

Through co-operation and an ongoing effort at all levels of society, Gothenburg is truly an example of how Agenda 21 can work, in Sweden and around the world. ●

CASE STUDY: WASA

Closed loop management A low risk



WASA, A LARGE SWEDISH INSURANCE FIRM, IS ACTIVELY ENCOURAGING CLOSED-CYCLE THINKING — internally and through their client base. According to an environmental report released this year, “environmental work is becoming increasingly business-driven. Demands from business partners are turning into a stronger driving force than requirements issued by public authorities.”

Lars Rosén, CEO of the WASA Group, notes, “Capital management utilises environmental criteria to an increasingly high degree for risk appraisal.” A company’s environmental performance, therefore, has been elevated in importance for assessments carried out by WASA. Dan Danielsson, WASA’s environmental manager, categorises clients into three types:

- Reactive companies, whose environmental measures are based on regulatory compliance;
- Receptive companies, whose approach is, “if we must improve environmentally, we must do it smartly”; and
- Proactive companies, whose environmental management practices are self-initiated and show leadership.

WASA gives preference to the third type, which it considers “low risk”. Clients in the other two categories are encouraged to develop environmental management systems closer to those of proactive clients, and are offered closed-cycle management counselling.

Unique to the insurance industry, WASA assesses a company’s

environmental management system from the top down. Insurers have traditionally attributed risks to technical problems, then human error (within the facility), and lastly, management. WASA discovered that the cause of most mishaps was traceable to management decisions and now evaluates a company’s environmental impact on the basis of its management system.

WASA’s environmental approach has also encouraged a deeper relationship with customers, allowing a better understanding of their core business. Employees have noted that a two-hour conversation can take place with the client before premium discussions even arise. With suppliers, WASA engages environmentally aware contractors and suppliers in claims handling. Since much of the company’s business revolves around automotive insurance, 120 car dismantlers were evaluated as part of their contracting process. Thirty bidders who demonstrated good environmental practices were awarded contracts.

Internally, WASA trains all employees to think in closed-cycle terms. Their insurance specialists, for example, are shown how to apply closed-loop concepts to their specific products. An exhaustive evaluation of office inputs, outputs, and resources was also done, measuring everything from the energy consumed, paper flow, and business travel by mode and distance, to the number of coffee mugs used by employees.

The firm’s environmental policy is based on a closed-cycle system

THIS FALL, AN AMERICAN LIFE-CYCLE RESEARCH GROUP — composed of government and industry representatives — will release the first publicly available products from their three-year effort to develop a life-cycle database tool. The database will support, manage, control and manipulate data for a set of common industrial commodities, including primary metals, bulk chemicals, forest products, plastics, glass and cement.

Recognition of the tremendous opportunities resulting from strategies that integrate energy and environmental considerations into all business practices sparked the U.S. Department of Energy's (DOE's)

Office of Industrial Technologies to initiate the project. The DOE's Pacific Northwest National Laboratory is co-ordinating the project and developing the database software.

Based on the review of an early prototype of the software by an industrial advisory group, the project team developed a detailed data specification for the "Life-Cycle Computer Data-Aided Project". The specification serves as the basis for documenting life-cycle assessment (LCA) data sets and designing the database software. LCA-related requirements emerging from the ISO 14000 standards process are reflected.

An advanced prototype was completed in 1995 and reviewed by group members in a workshop setting. In early 1996, a beta test version of the software was then distributed to a number of companies involved in the project.

Other companies, universities, and LCA practitioners are now reviewing both the software and commodities data, and a production version of the software is expected this fall. This initial version will include a group of basic LCA data sets for raw materials and energy forms. Additional data sets and software enhancements will result as the project continues over the next couple of years.

THROUGH A CANADIAN RESEARCH ALLIANCE of architects, economists, engineers and environmentalists, a computer model is being developed which will allow designers and researchers to assess the environmental implications of building designs. The model, dubbed ATHENA™, consolidates life-cycle assessment (LCA) databases and generates a composite environmental profile for all, or part of, a building's design.

ATHENA™ focuses on low-rise commercial, institutional, light industrial, and residential buildings, which account for more than 90% of all new-building construction in North America. It covers the life cycle of building products from resource extraction and manufacturing, through on-site construction, occupancy and maintenance, to demolition and disposal, recycling or reuse.

To initiate ATHENA™, the regional location of a building is selected from one of six pre-set cities. The appropriate electrical grid, source of building products, and transportation modes and distances are then determined.

The user then enters a structural design by selecting from a menu of over 50 typical floor, roof, and wall assemblies and/or by entering specific quantities of individual products. The assemblies are

on-site construction, including final transportation of individual products to the building site, are the subject of a separate database. Demolition energy estimates have yet to be added.

ATHENA™ An environmental assessment of building designs

composites of specific structural concrete, wood, and steel products for which environmental inventory data has been estimated and compiled in unit factor databases.

These product databases were developed through separate LCA studies. Each deals with typical production technologies, or technology mixes, for the relevant industry. They cover environmental effects from the resource extraction stage, through to the delivery of products to pre-set cities. Energy use and other effects associated with

ATHENA™ breaks down the selected assemblies into their respective products and consults the unit factor databases for the product-specific life-cycle environmental inventory estimates. It also calculates the primary energy used in the production of electricity and the pre-combustion energy associated with the production and delivery of fossil fuels consumed by each product, on a regional basis. It then compiles the inventory of total environmental inputs and outputs for the particular design.

Major government co-sponsors for funding include multiple offices within DOE, as well as the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Defense through the Strategic

the data development and is helping define the software system requirements from an industrial user's perspective.

Current industry organisations involved with the industry advisory group include: the Aluminum Association; American Petroleum Institute; American Plastics Council; Chemical Manufacturers Association; Electric Power Research Institute; National Council of the Paper Industry for Air and Stream Improvement; Portland Cement Association; and the Steel Recycling Institute.

To ensure compatibility with

other global efforts, project team members are participating in the European effort led by the Society for the Promotion of LCA Development (SPOLD), to develop a common LCA database specification. The team is also monitoring the parallel development of the Canadian Raw Materials Database (CRMD).

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U.S. life-cycle data project

Environmental Research and Development Program (SERDP). Participation by industry includes in-kind financial participation, including data collection, analysis, and an activities review. A formal advisory is providing guidance to

Results are presented as tabular and graphical summaries of each category of inventory data for a total design life cycle, showing the breakdown by activity stage. A more detailed report is also available, providing a breakdown of data by specific

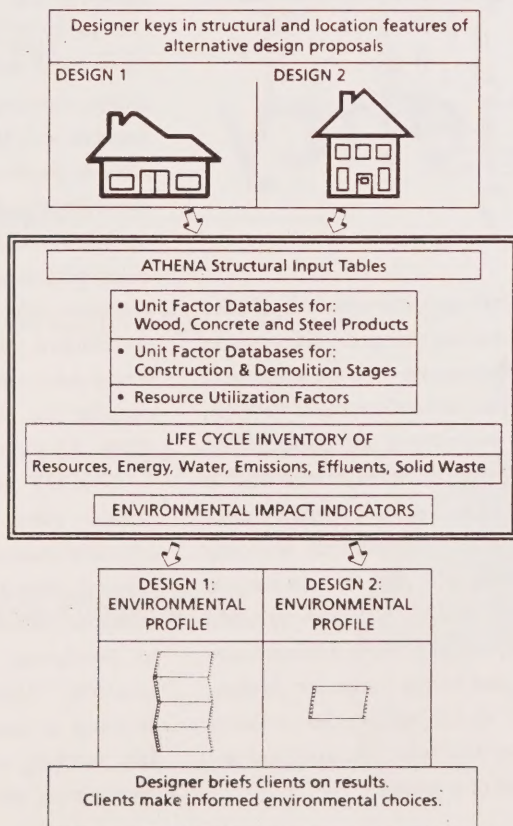
energy forms, waste substances, activity stages, and by assembly and product. ATHENA™ also allows users to save and display comparative summary results for up to five separate designs in order to weigh the relative effects of design changes.

ATHENA™ can be updated by revising unit factor databases to account for changing technologies, improved energy efficiencies, or other environmental gains at any activity stage. Unit factor estimates reflecting best available technologies can also be added to allow technological comparisons.

The research alliance responsible for the development of ATHENA™ was organised by Forintek Canada Corporation, with funding support from Natural Resources Canada.

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THE UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT (UNCED) challenged developed countries to reduce and eliminate unsustainable patterns of production and consumption. UNCED formally set the challenge in Agenda 21, Chapter 4, which states: "the major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production, particularly in industrialised countries." Sustainable Consumption and Production (SCAP) became the defining catch-phrase for all stakeholders.

The production side

Industry, through the World Business Council for Sustainable Development (WBCSD), addressed the issue in the paper, *Sustainable Production and Consumption: A Business Perspective*, February 1996. In it, the WBCSD states that the role of business in SCAP: "is to generate products and deliver services that bolster economic growth while minimising

to a level at least in line with the earth's estimated carrying capacity."

By this definition, eco-efficiency refers primarily to individual product life cycles. In comparison, SCAP is greater in scope, encompassing the entire commercial system and its interrelations.

Consequently, the WBCSD sees eco-efficiency as a corporate strategy and industrial ecology as the means to achieve it within an enterprise.

The paper also cites a number of innovations resulting in extended product life, reuse, and diversion from waste sites, such as Proctor and Gamble's ultra detergents, Thorn UK's re-manufactured appliances, and Roche's reusable Pharma Box. Clearly, WBCSD members have the initiative and the ingenuity to create a more "closed loop" approach to production.

Addressing consumption

Many advocates of sustainable consumption believe significant shifts in production and consumption

Within this framework, consumers are an integral part of the cycle. Instead of merely receiving goods and services, customers would use materials and energy resources temporarily, returning them to the industrial ecosystem for reprocessing and use.

However, the United Nations Commission on Sustainable Development (UNCSD), in a May 1996 advance report, noted that "...unlike consumption of energy and some materials, waste generation has shown no sign of declining from economic growth." It is further noted that "industry has launched a number of significant initiatives of its own. However, the long-term environmental and economic consequences of changes now underway or advocated are unclear." While UNCSD agrees on the importance of eco-efficiency on the production side, it also recommends that policy approaches encourage "alternative patterns of demand on the consumption side."

The WBCSD paper notes that "awareness needs to be raised among customers as to the value, benefits, and performance of eco-efficient products, re-manufactured products, reusable packaging, and used parts to reduce the stigma associated with their purchases." While awareness aids the decision to buy eco-efficient products and services, it may not encourage a customer to consider the idea of heed versus want.

UNCSD admits that little is known about the sociological aspects of consumer behaviour: "the cultural, ethical and other non-economic factors which contribute to purchasing and behavioural decisions." Understanding these decisions is essential in successfully working toward sustainable development. ●

Is eco-efficiency enough?

environmental consequences. Business can also influence demand in its role as a consumer of goods and services."

Eco-efficiency is cited as a means to accomplish SCAP. At their 1993 Antwerp Workshop, the WBCSD developed a definition of eco-efficiency: "Eco-efficiency is reached by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle,

patterns cannot be achieved without a far-reaching change in public attitudes and aspirations — a reorientation of people's views about material wealth, the environment and quality of life.

The WBCSD paper states that "to achieve the goal of a closed industrial ecosystem, the industrial economy and society as a whole must become more cyclic." A closed industrial ecosystem is envisioned where materials and energy sources are continually "cycled" within the economy rather than being consumed and disposed of as wastes.

WHILE THE TERM 'INDUSTRIAL ECOSYSTEM' IS CONSIDERED AN OXYMORON BY SOME, an increasing number of researchers and business visionaries called industrial ecologists endorse these systems as sustainable industrial development. Industrial ecology is a term which first cropped up in Japan in the seventies, and has since migrated across Europe and North America. Today, there are at least 12 definitions of this rapidly developing field of study. Most refer to the design of products, processes and industrial infrastructures which interlock with natural ecosystems to improve the efficiencies of material flows and reduce the ecological footprint of an industry's processes and products. Industrial ecosystems support the cycling of materials and symbiotic relationships between businesses.

As with natural systems, interlocking occurs at different spatial levels (i.e., within and between companies at the local, regional, national and, in some instances,

global level). In the latter case, the scarcity and value of materials such as platinum may warrant a global approach. One example of interlocking is the development

surplus gas and cooling water from a nearby refinery. It then delivers process steam to a pharmaceutical plant, and hot water to a fish farm and to the municipality for district

Industrial ecosystems: An oxymoron?

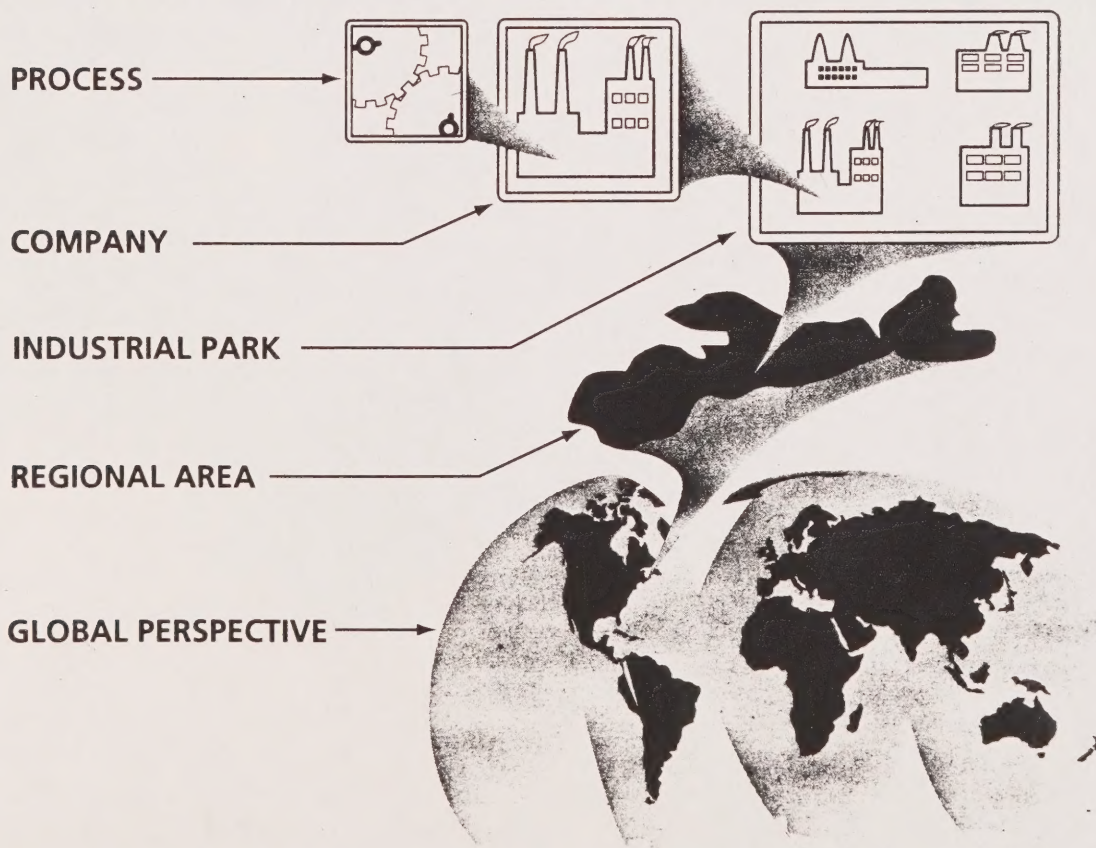
of a regional ecosystem for the cycling of materials used by automobile manufacturers in Europe such as Volkswagen and Mercedes-Benz. Another is the local industrial ecosystem developed in Kalundborg, Denmark. Over a twenty-year period, industrialists and municipal leaders in Kalundborg have found ways of using residual materials and energy productively for the economic and environmental benefit of all.

The coal-fired power plant in Kalundborg, for example, receives

heating. The gypsum removed from its scrubbers is delivered to a gyproc plant to offset a large percentage of the gypsum it had previously purchased in Portugal.

The sulphur removed from the oil refinery's pollution control equipment is delivered to a sulphuric acid maker. The sludge from the pharmaceutical plant's operations goes to farmers for a fertilizer supplement. These examples are merely a sampling of the symbiotic relationships developed in Kalundborg. More

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Industrial ecosystems: An oxymoron?

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are being investigated as industries compatible with the town's ecosystem are found.

Since this system occurred more by good fortune than planning, a number of researchers are beginning to investigate strategic approaches and techniques for developing similar industrial ecosystems. In the United States, the President's Council on Sustainable Development and the Environmental Protection Agency (EPA) have recognised the potential for industrial ecosystems. In the last two years, research into eco-industrial parks has been underway in Brownsville, Texas;

Baltimore, Maryland; Cape Charles, Virginia; and Chattanooga, Tennessee. A field book for designing eco-industrial parks has resulted and will be published later this year.

Further work is being supported by the Zero Emissions Research Initiative established by Gunter Pauli, an industrial visionary now based at the United Nations University in Tokyo. He is collaborating with researchers in Chattanooga, as well as with the Hon. Hugh Faulkner of Sustainable Project Management on projects in developing countries.

Canadian initiatives in the area of industrial ecology have been concurrent with those in Japan, Europe and the United States. In Dartmouth, Nova Scotia, for example,

a multi-disciplinary team of researchers from three universities has been investigating industrial parks as ecosystems since 1992. Using Burnside Industrial Park as its experimental site, the team has been developing principles, guidelines and strategies, as well as exploring the nature of symbiotic relationships that might be established and the types of support systems which would be required. Several reports have been published with financial support from federal and provincial agencies and foundations. The work has gained considerable international recognition, and the team is now collaborating with the Industry and Environment Activity Centre of the United Nations Environment Program (UNEP) on a technical manual concerning environmental management of industrial estates.

CASE STUDY: WASA

derived from several programs, including: The Natural Step; the International Chamber of Commerce (ICC) Commerce and Industry Program for a Sustainable Future; sustainable development appraisals from the Brundtland Commission's Report, "Our Common Future"; and documents such

as Agenda 21 from the 1992 United Nations Conference on the Environment and Development. WASA is also a signatory of the United Nations Environment Program (UNEP) "Statement of Environmental Commitment by the Insurance Industry." ●

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